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Development of fern prothallia.—Working under KLEBS, ISABURO-NAGAI²⁶ gives further evidence, through an investigation of the physiology of fern prothallia, in support of the idea that the course of development in plants is largely dependent upon and influenced by external factors. The author divides his work into four parts, dealing respectively with the germination of the spore, the development of the prothallium, the production of rhizoids and sex organs, and the formation of adventitious branches.

The paper gives an exhaustive summary of previous investigations dealing with the prothallium in ferns, and describes also a considerable amount of original investigation carried out with a view to ascertaining the effect of external conditions upon the qualitative and quantitative courses of development of the gametophyte. By far the most interesting and significant feature of the work is the extent to which the investigator is able to induce or inhibit the formation of sex organs, the appearance of apogamy, and finally of adventitious shoots. Interesting, too, but possibly of less significance, are the changes of form which he seems able to produce in the thallus.

He finds, for instance, that where the nutrient solutions on which the spores are germinated are poor in potassium, magnesium, and calcium, both antheridia and archegonia may be formed; on the other hand, while antheridia may be formed quite readily in a solution containing little or no nitrogen, the production of archegonia cannot take place. In other forms, where germination and vegetative growth go on in darkness as in light with equal facility, no antheridia are set in the former instance. The experiments further point to a direct connection between the concentration of the nutrient solution and the production of sex organs, since under scant illumination archegonia are not developed in the weaker concentrations. Still other results indicate that if the prothallium be kept under conditions favoring vegetative growth, sex organs will not appear; and the author concludes from this that sex organs are produced only on prothallia whose vegetative growth has been hampered (ameristic prothallia).

In this connection, ISABURO-NAGAI brings up the question of the distribution of sex organs, pointing out the fact that whereas the antheridia are generally scattered over the entire prothallial surface, the archegonia are restricted to the meristematic region around the notch. His explanation of this situation, however, is far from satisfactory, and will need considerable experimental backing before it is given general acceptance. Briefly, the author first remarks the difference between the egg and the sperm, in that the latter is poor in albumen, with which the former is abundantly supplied; secondly, that the cells of the apical region of the prothallium are also rich in albumen; and thirdly, that the archegonia are probably restricted to this apical region because they derive their excessive protein supply from the meristematic cells.

²⁶ ISABURO-NAGAI, Physiologische Untersuchungen über Farnprothallien. *Flora* 106:281-330. figs. 18. 1914.

If this be true, it is probably the only case on record where the actively dividing members of a meristem act as nurse cells.

One of the most striking experimental results ISABURO-NAGAI publishes concerns his control of the formation of adventive branches. While he is unable to duplicate the results of HEILBRONN²⁷ in inducing adventive branching by exposing the prothallia to such narcotics as ether and chloroform, he finds that plasmolysis of the cells of the gametophyte will induce luxuriant formation of the vegetative shoots. In his explanation of this fact he makes the statement that the stimulus of plasmolysis is a purely physical one, consisting probably of the withdrawal of water from the cell. The possibility of this stimulus being chemical in its nature is precluded, because plasmolytic agents of widely different chemical nature all produce the same effect. He believes, also, that this is not a traumatic response, since wounding the thallus with a fine needle will not produce or stimulate the production of adventive branches. He accepts as a solution of the question the explanation of KLEBS who claims that the normal cell growth, at first rapid, is checked by the formation in the cell sap of deleterious substances. These are either withdrawn in the plasmolysis, allowing the initiation of renewed and vigorous growth when once the cell has returned to the normal condition, or else they are rendered inactive by the concentration of the cell sap during plasmolysis. A further hypothesis is that the growth of the older cells is checked by the younger cells through the direct protoplasmic connections between the two; that plasmolysis ruptures these connections; and that, therefore, upon the return to the normal condition vigorous growth may be resumed.

The investigation is concluded with a few additional facts on the influence of light upon germination, which are of no particular significance, inasmuch as they merely add a few names each to the lists of those spores which can germinate in darkness, and those which cannot.—HERMANN B. DEUTSCH.

²⁷ HEILBRONN, A., Apogamie, Bastardierung, und Erblichkeitsverhältnisse bei einigen Farnen. *Flora* 101:1-42. 1910.